Lat 39.95144 Lon -120.97001

Forest Health Protection

Pacific Southwest Region
Northeastern California Shared Service Area

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To: Darrel Jury and Feather River Land Trust

Subject: Heart K Forest Health Project (FHP Report NE13-10)

At the request of Darrel Jury, (Environmental Studies Instructor – Feather River College and Project Manager for the Heart K Forest Health Project), Danny Cluck, Forest Health Protection (FHP) Entomologist, visited proposed hand thinning units on April 10, 2013. The objective of this visit was to evaluate stand conditions and thinning prescriptions to determine the potential risks of tree mortality associated with bark beetle (*Ips* spp.) activity in green pine slash. Darrel Jury, Mike Savala (Crew Boss, Greenville Rancheria Wildland Fire Crew) and Phil Noia, (Consulting Arborist and FR-RCD President) accompanied me in the field.

Description of the project area

The Heart K Forest Health Project is located approximately 7 miles southeast of Taylorsville, CA, on the south side of Indian Creek (T25N, R11E, Secs. 1, 11 and 12). The elevation ranges from 3,750 – 4,350 feet with annual precipitation between 30 and 40 inches. The forest type is Sierra mixed conifer dominated by ponderosa pine (*Pinus ponderosa*) at the lower elevations and Douglas-fir (*Pseudotsuga menziesii*) at the upper elevations. The other species present by order of abundance are incense cedar (*Calocedrus decurrens*), black oak (*Quercus kelloggii*) and sugar pine (*Pinus lambertiana*). The majority of all trees within the project area are <10" diameter breast height (dbh). The objectives of the project are to remove most stems that are <10" dbh to reduce ladder fuels and decrease stand density and to treat surface fuels through piling and burning excess large woody debris and broadcast burning fine surface fuels.

General observations

Upper elevation area: This area is mostly a dense stand of small diameter trees dominated by Douglas fir and incense cedar. Larger diameter trees (>10" dbh) are primarily ponderosa pine, Douglas-fir and black oak. Recent mortality (past 5 – 10 years) of Douglas-fir of all size classes is apparent throughout the stand. Douglas-fir are succumbing to repeated attacks by the flatheaded fir

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borer (*Pheanops drummondi*) and the Douglas-fir engraver beetle (*Scolytus unispinosus*) associated with drought stress. Several incense cedars are also dying from a combination of incense-cedar rust (*Gymnosporangium libocedri*) and drought stress. A couple of ponderosa pines were observed with low levels of western dwarf mistletoe (*Arceuthobium campylopodum*) infection in the lower crowns.

Lower elevation area: This area is also heavily stocked with many small diameter trees but dominated by ponderosa pine. No current insect or disease activity was observed in these unthinned stands but there is an abundance of downed stems in some locations; evidence of past bark beetle caused mortality associated with high stand density and drought. However, two dying ponderosa pines were observed in a previously thinned portion of the stand that appeared to be infected with Heterobasidion root disease caused by the fungus *Heterobasidion irregulare*.

Recent bark beetle activity in the surrounding area

Northeastern California forests are currently experiencing elevated levels of bark beetle activity based on the results of FHP aerial detection surveys. This activity is mostly associated with recent below normal precipitation combined with high stand densities. FHP aerial detection surveys in 2012 mapped elevated levels of ponderosa pine, sugar pine and Douglas-fir mortality within a 5 mile radius of the Heart K project area. This mortality was all associated with bark beetle activity and varied from a few scattered trees in the case of sugar pine to large 25+ tree groups in the case of Douglas-fir. While the bark beetles associated with this tree mortality are not considered a direct threat to the Heart K project area, the elevated mortality does highlight the level of moisture stress that trees are currently experiencing in the area. If you would like to view the aerial survey spatial data please visit the FHP website: http://www.fs.usda.gov/detail/r5/forest-grasslandhealth/?cid=fsbdev3_046696

Management considerations for Ips bark beetles

Cutting and piling small diameter pines within a stand can lead to subsequent buildup of Ips bark beetles that infest and reproduce in the green material during the late spring and early summer. These beetles can then emerge later in summer and attack adjacent residual pines when they are experiencing moisture stress and are more susceptible to attack. These attacks can lead to top-kill or whole tree mortality. Dry years, especially years with a dry late winter and spring (such as the current year), are considered high risk for Ips bark beetle problems.

In northeastern California, green pine slash is typically attacked by the California Fivespined Ips (*Ips paraconfusus*) on the westside of the Sierra/Cascade crest and the pine engraver (*Ips pini*) on the eastside. Historically, *I. paraconfusus* tends to be the species that causes the most problems when green pine slash is created by windthrow, snow breakage, logging or thinning activities. Very few problems have ever been documented for *I. pini* activity. The main flight period for both species is approximately March through June depending on elevation and latitude. It is important to note that only pine species (e.g. ponderosa and Jeffrey pine) are hosts for *I. paraconfusus* and *I. pini* and the information provided on slash management and risk does not apply to non-host species (e.g. Douglas-fir and incense cedar). Green slash consisting of these non-host tree species may be attacked by other bark beetle species but this activity is not considered a potential problem.

In general, smaller piles scattered throughout a thinned stand can be more problematic than large piles restricted to common landings. Drought and residual stand density are important factors in causing tree stress that can increase susceptibility to Ips attack. Pine slash (>3-4" diameter) that is created from January through June tends to be the most suitable for brood production leading to a population build up that can attack residual live trees later in summer. Ips beetles almost always attack fresh slash piles and downed logs but it is the subsequent brood success and the health of the residual trees that can lead to tree mortality.

Besides managing the timing of slash creation, cutting tree boles to a short length (<3 feet) and also placing them in exposed locations to facilitate drying can reduce habitat suitability for Ips. Green slash piles should also be located as far away from residual pines as possible as beetles that are attacking slash sometimes slop over and attack adjacent pines (See Appendix A for more information).

Potential for Ips-caused tree mortality in the Heart K project area

In the Heart K project area, any green pine slash created from now until approximately July will most likely be attacked by the California Fivespined Ips (*Ips paraconfusus*) and possibly to a lesser extent by the pine engraver (*Ips pini*). However, due to the high tree species diversity in most locations, there will be a limited amount of pine material created that can be utilized by Ips bark beetles. Slash piles will consist primarily of non-host tree species and therefore will have low suitability for Ips brood production that could lead to subsequent pine mortality.

Due to the high species diversity at the upper elevations of the project area, thinning activities can occur anytime with a low risk of causing Ips bark beetle problems. Lower elevation areas that are dominated by ponderosa pine should be thinned no earlier than July 1 and no later than December 1. Slash created during this time avoids the peak flight period for Ips and will likely dry out and become unsuitable for significant brood production before beetle flight begins the following spring.

Other insect and disease considerations for the Heart K project area

The observed infection of incense cedar by incense cedar rust would generally not result in tree mortality during periods of normal to above normal precipitation as this disease rarely causes any more injury than scattered dieback of small branches. However, when combined with moisture stress, these trees are at a higher risk than uninfected trees and a continuation of dry and overstocked conditions may result in further mortality. To reduce future mortality, select heavily infected trees (trees with excessive brooms) for removal during thinning operations.

Western dwarf mistletoe and Heterobasidion root disease infections observed during this visit appear to be occurring at a very low level within the stand and therefore are not likely to interfere with management objectives for the area.

Sugar pine should be retained as much as possible during the thinning operation in order to preserve genetic diversity and avoid the removal of potential white pine blister rust (*Cronartium ribicola*) resistant individuals. White pine blister rust, a non-native pathogen, has continued to

weaken and kill this species over most of its range since its introduction into the Pacific Northwest in 1910.

Considerations for prescribed fire and pile burning

If prescribed fire is used as a follow-up treatment to stand thinning, unacceptable levels of large diameter pine mortality may occur depending on management objectives. This mortality most often occurs as a direct result of cambium or crown injury to individual trees during the fire. Mature Jeffrey, ponderosa and especially sugar pines are susceptible to mortality during prescribed burns because of the deep duff and litter that has accumulated at their base in the absence of fire. These duff mounds typically burn at a slow rate, while maintaining lethal temperatures, causing severe cambium injury. To protect individual large diameter pine from lethal cambium injury, raking the duff away from the bases of these trees before burning (within 24" of the bole and down to mineral soil) is recommended.

To minimize fire-related injuries to residual trees caused by pile burning, piles should be located away from tree boles and from under tree crowns as much as possible. Depending on severity, fire-injured trees may become more susceptible to bark and engraver beetle attack.

If you have any questions regarding this report and/or need additional information please contact me at 530-252-6431.

/s/ Danny Cluck

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Appendix A - Insect and Disease Information

Ips spp.

Ips spp. attacks have been recorded on most species of pines in California. These beetles kill saplings, poles and sawtimber up to about 26 inches dbh and the tops of even larger trees. Attacks on live trees are usually limited to trees which are suppressed, or stressed by dwarf mistletoe, root disease, drought, fire or the attack of other insects. If fresh slash is available in the spring, pine engravers may build up in an area and cause localized mortality or top killing by mid-summer.

Attacks are made with the coming of warm weather in the spring. Attacking males bore nuptial chambers in the inner bark and release a pheromone which attracts other beetles to the attack site. If many beetles are attracted, they may attack nearby trees and cause a group kill. Within a day or two of the attack by the male, two to five females enter the nuptial chamber and after mating, each female bores an individual egg gallery which lightly scores the sapwood. The size and pattern of the combined gallery pattern is often diagnostic of the species of Ips involved. The galleries are kept open by beetles pushing boring dust out through the entrance hole. Red boring dust collecting in bark crevices or spider webs is diagnostic of a successful attack. Eggs are laid in niches along the sides of the galleries. Larvae hatch from the eggs and feed in the phloem. They eventually pupate in cells at the end of their larval mines and transform to adults.

A new generation is produced in as little as 6-8 weeks in the spring to 4-6 weeks in mid-summer (August). Thus, several overlapping generations per year may be produced. The winter may be passed in any of the life stages of larvae, pupae, or adults, depending upon which *Ips* species is involved.

Outbreaks in standing, healthy trees are sporadic and of short duration, and are often associated with some temporary stress or shock afflicting the host species, such as drought or logging disturbance. Tree killing frequently occurs where green pine slash, which serves as breeding habitat is left untreated during spring and summer. To be suitable as *Ips* breeding habitat, pine slash must have bark from 1/8 to 1 inch thick (usually 3 to 26 inches diameter), must have succulent cambium and must remain moderately cool during the development period.

Fresh pine slash caused by thinning, dwarf mistletoe control work, construction or winter storm breakage can be modified in a number of ways to make it unsuitable for *Ips* breeding. One approach to minimizing damage is to schedule slash-generating activities mostly between mid-July and late-December, when the slash has a high probability of drying out, heating up, or spoiling before the beetles can complete their development. Utilization of the cut material to the smallest possible diameter will minimize the amount of breeding material available to *Ips* beetles. If green pine slash must be created during the spring and early summer, slash treatments are available to prevent the buildup of pine engraver populations. Because *Ips* beetles can complete their development in about a month under ideal conditions, treatment should be carried out soon after cutting to be effective.

Slash treatment methods which generally work well include chipping, lopping and scattering slash in sunny areas to heat it up, crushing or mashing slash with logging equipment to make it unsuitable for *Ips* breeding, or piling and burning the slash within a month of cutting. Broadcast burning the slash might work if it could be done without damaging the residual stand. A method which has worked during the summer in hot climates is to pile slash in a sunny area and tightly cover the pile with clear plastic. If the temperature under the bark of slash in all parts of the pile reaches 120^{o}F, all brood currently in the pile will be killed. Lower temperatures will not be effective and, where successful, this method will not prevent reinfestation of slash piles. Because most *Ips* attacks occur within a quarter-mile from the location where the beetles emerged,

high value pines can be given some protection by removing fresh pine slash to areas which do not have pines.

Two practices which should generally be avoided are piling fresh pine slash without further treatment, and allowing slash to touch or remain near valuable leave trees.

Heterobasidion Root Disease (formerly Annosus Root Disease)

Heterobasidion spp. is a fungus that attacks a wide variety of woody plants. All western conifer species are susceptible. Madrone (*Arbutus menziesii*), and a few brush species (*Arctostaphylos spp.* and *Artemisia tridentata*) are occasional hosts. Other hardwood species are apparently not infected. The disease has been reported on all National Forests in California, with incidence particularly high on true fir in northern California, in the eastside pine type forests, and in southern California recreation areas.

Heterobasidion root disease is one of the most important conifer diseases in Region 5. Current estimates are that the disease infests about 2 million acres of commercial forestland in California, resulting in an annual volume loss of 19 million cubic feet. Other potential impacts of the disease include: increased susceptibility of infected trees to attack by bark beetles, mortality of infected trees presently on the site, the loss of the site for future production, and depletion of vegetative cover and increased probability of tree failure and hazard in recreation areas.

During periods favorable to the fungus, fruiting bodies (conks) form in decayed stumps, under the bark of dead trees, or under the duff at the root collar. New infection centers are initiated when airborne spores produced by the conks land and grow on freshly cut stump surfaces. Infection in true fir may also occur through fire and mechanical wounds, or occasionally, through roots of stumps in the absence of surface colonization. From the infected stump surface, the fungus grows down into the roots and then spreads via root-to-root contact to adjacent live trees, resulting in the formation of large disease centers. These infection centers may continue to enlarge until they reach barriers, such as openings in the stand or groups of resistant plants. In pines, the fungus grows through root cambial tissue to the root crown where it girdles and kills the tree. In true fir and other non-resinous species, the fungus sometimes kills trees, but more frequently is confined to the heartwood and inner sapwood of the larger roots. It then eventually extends into the heartwood of the lower trunk and causes chronic decay and growth loss.

Heterobasidion root disease in western North America is caused by two species: *Heterobasidion occidentale* (also called the 'S' type) and *H. irregulare* (also called the 'P' type). These two species of *Heterobasidion* have major differences in host specificity. *H. irregulare* ('P' type) is pathogenic on ponderosa pine, Jeffrey pine, sugar pine, Coulter pine, incense cedar, western juniper, pinyon, and manzanita. *H. occidentale* ('S' type) is pathogenic on true fir, spruce and giant sequoia. This host specificity is not apparent in isolates from stumps; with *H. occidentale* being recovered from both pine and true fir stumps. These data suggest that infection of host trees is specific, but saprophytic colonization of stumps is not. The fungus may survive in infected roots or stumps for many years. Young conifers established near these stumps often die shortly after their roots contact infected roots in the soil.

Dwarf Mistletoe

Dwarf mistletoes (Arceuthobium spp.) are parasitic, flowering plants that can only survive on living conifers in the Pinaceae. They obtain most of their nutrients and all of their water and minerals from their hosts.

Dwarf mistletoes spread by means of seed. In the fall the fruit ripen and fall from the aerial shoots. The seeds are forcibly discharged. The seed is covered with a sticky substance and adheres to whatever it contacts. When a seed lands in a host tree crown, it usually sticks to a needle or twig, where it remains throughout the winter. The following spring the seed germinates and penetrates the twig at the base of the needle. For the next 2-4 years, the parasite grows within the host tissues, developing a root-like system within the inner bark and outer sapwood, and causing the twig or branch to swell. Aerial shoots then develop and bear seed in another 2-4 years.

Dispersal of dwarf mistletoe seeds is limited to the distance the seeds travel after being discharged. From overstory to understory, this is usually 20 to 60 feet, but wind may carry them as far as 100 feet from the source. A rule of thumb is that the seeds can travel a horizontal distance equal to the height of the highest plant in an infected tree. There is some evidence that long distance spread of dwarf mistletoe is occassionaly vectored by birds and animals.

Vertical spread within tree crowns of most dwarf mistletoes is limited to less than one foot per year because of foliage density. Because of the thin crowns of gray pine, however, the vertical rate of spread has been measured as being greater than 2 feet per year. This rate of spread equalled or exceeded the rate of height growth of infected trees.

Dwarf mistletoes are easy to identify because they are generally exposed to view within a tree's crown. Signs of infection include the yellow-green to orange mistletoe plants, basal cups on a branch or stem where the plants were attached and detached plants on the ground beneath an infected tree. Symptoms include spindle-shaped branch swellings, witches' brooms in the lower crown, and bole swellings.

White pine blister rust

White pine blister rust is caused by Cronartium ribicola an obligate parasite that attacks 5-needled pines and several species of Ribes spp. The fungus needs the two alternate hosts to survive, spending part of its life on 5-needled pines and the other on Ribes spp. The disease occurs throughout the range of sugar pine to the southern Sierra Nevada, but has not been reported further south. Infection of pines results in cankers on branches and main stems, branch mortality, top kill, and tree mortality.

Spores (aeciospores) produced by the fungus in the spring on pine bole or branch cankers are wind-disseminated to Ribes spp. where they infect the leaves. Spores (urediospores) produced in orange pustules on the underside of the leaves reinfect other Ribes spp. throughout the summer, resulting in an intensification of the rust. A telial spore stage forms on Ribes spp. leaves in the fall. Teliospores germinate in place to produce spores (sporida) which are wind-disseminated to pines and infect current year needles. Following infection, the fungus grows from the needle into the branch and forms a canker. After 2 or 3 years, spores are produced on the cankers and are spread to Ribes spp. to continue the cycle. Although blister rust may spread hundreds of miles from pines to Ribes spp., its spread from Ribes spp. back to pines is usually limited to a few hundred feet.

Branch cankers continue to enlarge as the fungus invades additional tissues and moves toward the bole. Branch cankers within 24 inches of the bole will eventually form bole cankers. Bole cankers result in girdling and death of the tree above the canker. Cankers that have margins more than 24 inches from the main bole are unlikely to reach the bole and only branch flagging will result.